REMARKS

The Office Action dated January 3, 2008, and made final, has been carefully reviewed and the foregoing amendment has been made in consequence thereof.

Claims 1-31 are pending in this application. Claims 1-31 stand rejected.

Applicants respectfully note that the Examiner has not addressed the Applicants' arguments made in the response to the Office Action mailed April 19, 2007 with respect to the double patenting rejections. Although the Examiner asserts on page 2 that the previous rejection is being maintained, it appears as though only the Section 103 rejections are being maintained. Accordingly, Applicants proceed as though only the Section 103 rejections are maintained and that the double patenting rejections have been withdrawn. Applicants respectfully request that the Examiner acknowledge that the double patenting rejections have been withdrawn.

Applicants respectfully note that the Examiner has not addressed all of Applicants' arguments made in the response to the Office Action mailed April 19, 2007 with respect to the Section 103 rejections. More specifically, Applicants' arguments directed to the non-obviousness of combining Willson, Townsend, Carroll, Fessler, and/or Leuchter to arrive at the present claims are not addressed in the Final Office Action. "Office personnel should consider all rebuttal arguments and evidence presented by applicants." MPEP § 2145. Accordingly, Applicants respectfully request that the Examiner consider all of Applicants' arguments as to why it would not be obvious to one of ordinary skill in the art to combine the cited references, rather than merely restating the reasons for rejection given in prior Office Actions.

The rejection of Claims 1-6, 8, 14, 18-28, and 31 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 6,018,562 to Willson (hereinafter referred to as "Willson") in view of U.S. Pat. No. 6,490,476 to Townsend et al. (hereinafter referred to as "Townsend") is respectfully traversed.

Willson describes an automatic recognition system (10) for recognizing concealed objects and features thereof. The system (10) includes an L-shaped source array (1) and an L-shaped detector array (2). The source array (1) includes a plurality of X-ray sources (12-

15) that are spaced apart along the length of the source array (1). Each of the X-ray sources (12-15) is activated in a predetermined sequence by the controller (6) such that only one X-ray beam (16-19) is produced at any one instant by one source array (1) and its corresponding co-planar detector array (2). Each fan beam (16-19) includes X-ray photons having a known energy distribution of varying energy levels within a fixed energy band (E_1, E_2, E_3, E_4, and/or E_5) associated with each fan beam (16-19). A plurality of multi-channel analyzers (MCA) (3) are coupled to the detector array (2) such that each MCA (3) counts the number of photons for a set period of time in each energy level or band (E_1-E_5) within a selected energy spectrum. Using attenuation factors (μ_1-μ_5) associated with each energy band (E_1-E_5), a processor (4) identifies an object (21) according to the attenuation factors (μ_1-μ_5) and reference attenuation factors. Notably, Willson does not describe or suggest acquiring, from scanning at two X-ray tube potentials, first image data including attenuations from a Compton process and second image data including attenuations from a photoelectric process.

Townsend describes a positron emission tomography/X-ray computerized tomography (PET/CT) scanner (10) that combines a spiral CT scanner (12) with a rotating PET scanner (14). A CT scan is acquired before the PET scan, following injection of ^{18}F-FDG activity into a patient. The CT scan is operated at 70 keV. The CT images from this scan are reconstructed on the CT acquisition computer and then transferred to the PET console. Using a hybrid scaling method, the CT images are used to generate the attenuation correction factors for correcting a PET image. "This hybrid scaling method is based on the principal that, over the photon energy range covering both CT and PET (40 to 511 keV), Compton scattering is the most important physical process for the interaction of photons with matter such as air, water, and soft tissue." Col. 16, lines 65-67; col. 17, lines 1-3. Moreover, Townsend describes that "[a]t 511 keV, the contribution from the *photoelectric effect is essentially negligible*. All photon interaction in biological tissues, including bone, is *dominated by Compton scattering*." Col. 17, lines 19-22 (emphasis added). More specifically, in the hybrid scaling method the CT images are scaled by first dividing the CT image into regions of classified pixels, scaling the pixel values, and forward projecting the segmented and scaled CT images to obtain the correction factors. The generated CT images are used as a basis for the attenuation correction of PET data to reduce the increased statistical noise in the PET image due to the PET transmission scan. Notably, Townsend does not describe or suggest acquiring, from scanning at two X-ray tube potentials, first

image data including attenuations from a Compton process and second image data including attenuations from a photoelectric process.

Townsend further describes that "[t]he PET/CT scanner of the present invention is of particular utility in the thorax and abdomen due to the difficulty of aligning PET and CT images (with the exception of the brain) that are acquired on separate scanners, and because of the frequent difficulty of interpreting ^{18}F-FDG PET studies in the abdomen." Col. 18, line 65 – col. 19, line 3. Many registration techniques have been developed for use in cerebral studies, but "the problems of alignment and coregistration in other regions of the human body are more difficult to solve owing to the absence of even low-resolution morphology in the functional image." Col. 3, lines 7-20. The above-mentioned problems arise because "[w]hile the brain remains fixed in the skull, the position of organs such as the liver may depend upon the precise way in which the patient lies on the bed. Thus, PET-CT post-hoc alignment may be affected by different internal relationships and deformations within the body, limiting the accuracy of such an approach." Col. 3, lines 56-62. Accordingly, the PET/CT system (10) described in Townsend "allows registered CT and PET images to be acquired sequentially in a single device, overcoming alignment problems due to internal organ movement, variations in scanner bed profile, and positioning of the patient for the scan." Col. 12, lines 17-21.

Claim 1 recites a method for obtaining data, said method comprising "scanning at least one of a head of a patient and a neck of the patient with a Multi-Energy Computed Tomography (MECT) system, the MECT including an x-ray source rotatable about the patient, the MECT configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect and within an energy region associated with medical computed tomography (CT) . . . acquiring, from said scanning, first image data including attenuations from a Compton process and second image data including attenuations from a photoelectric process . . . and representing a material within the acquired image data using at least one of a density of a first reference material and a density of a second reference material."

Neither Willson nor Townsend, considered alone or in combination, describes or suggests a method for obtaining data as recited in Claim 1. More specifically, neither Willson nor Townsend, considered alone or in combination, describes or suggests a method that includes acquiring, from scanning at two X-ray tube potentials, first image data including attenuations from a Compton process and second image data including attenuations from a

photoelectric process. Furthermore, neither Willson nor Townsend, considered alone or in combination, describes or suggests a method that includes representing a material within acquired image data using at least one of a density of a first reference material and a density of a second reference material. Rather, in contrast to the present invention, Willson describes determining attenuation factors associated with each energy band of a plurality of X-ray fan beams to identify an object according to the determined attenuation factors and reference attenuation factors, and Townsend describes a hybrid scaling method that is based on Compton scattering because Compton scattering is the most important physical process for the interaction of photons with matter.

Accordingly, and for at least the reasons set forth above, Claim 1 is submitted to be patentable over Willson in view of Townsend.

Claims 1-6, 8, 14, and 18-22 depend, directly or indirectly, from independent Claim 1. When the recitations of Claims 1-6, 8, 14, and 18-22 are considered in combination with the recitations of Claim 1, Applicants submit that dependent Claims 1-6, 8, 14, and 18-22 likewise are patentable over Willson in view of Townsend.

Claim 23 recites a Multi-Energy Computed Tomography (MECT) System configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect, the MECT comprising "a radiation source rotatable about a patient . . . a radiation detector . . . and a computer coupled to said radiation source and said radiation detector, said computer configured to . . . receive first image data regarding a first scan at a first energy spectrum, the scan being a scan of a head of the patient, the first image data including attenuations from a Compton process . . . receive second image data regarding a second scan at a second energy spectrum, the second scan being a scan of the head, wherein the first energy spectrum and the second energy spectrum are within an energy region associated with medical computed tomography (CT), the second image data including attenuations from a photoelectric process . . . generate an image of at least one of a cerebral blood volume of the patient and a cerebral blood flow of the patient using the first and second image data, wherein a material within at least one of the cerebral blood volume and the cerebral blood flow is represented using at least one of a density of a first reference material and a density of a second reference material . . . and calculate a mean transit time of the cerebral blood flow based on the received data."

Neither Willson nor Townsend, considered alone or in combination, describes or suggests a Multi-Energy Computed Tomography (MECT) System as recited in Claim 23. More specifically, neither Willson nor Townsend, considered alone or in combination, describes or suggests a MECT that includes a computer configured to receive first image data regarding a first scan at a first energy spectrum, wherein the first image data includes attenuations from a Compton process, and to receive second image data regarding a second scan at a second energy spectrum, wherein the second image data includes attenuations from a photoelectric process. Furthermore, neither Willson nor Townsend, considered alone or in combination, describes or suggests a MECT that includes a computer configured to generate an image of at least one of a cerebral blood volume of a patient and a cerebral blood flow of the patient, wherein a material within at least one of the cerebral blood volume and the cerebral blood flow is represented using at least one of a density of a first reference material and a density of a second reference material. Moreover, neither Willson nor Townsend, considered alone or in combination, describes or suggests a MECT that includes a computer configured to calculate a mean transit time of a cerebral blood flow based on received data. Rather, in contrast to the present invention, Willson describes determining attenuation factors associated with each energy band of a plurality of X-ray fan beams to identify an object according to the determined attenuation factors and reference attenuation factors, and Townsend describes a hybrid scaling method that is based on Compton scattering because Compton scattering is the most important physical process for the interaction of photons with matter.

Accordingly, and for at least the reasons set forth above, Claim 23 is submitted to be patentable over Willson in view of Townsend.

Claims 24-26 depend directly from independent Claim 23. When the recitations of Claims 24-26 are considered in combination with the recitations of Claim 23, Applicants submit that dependent Claims 24-26 likewise are patentable over Willson in view of Townsend.

Furthermore, with respect to Claims 25 and 26, on page 5 of the Office Action, the Examiner acknowledges that "Wilson [*sic*] and Townsend et al. do not explicitly teach performing a Basis Material Decomposition (BMD) of the acquired data." Accordingly, Applicants respectfully submit that Claims 25 and 26 are patentable over Willson in view of Townsend.

Claim 27 recites a Multi-Energy Computed Tomography (MECT) System configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect, the MECT comprising "a radiation source rotatable about a patient . . . a radiation detector . . . and a computer coupled to said radiation source and said radiation detector, said computer configured to . . . receive first image data regarding a first scan at a first energy spectrum, the scan being a scan of at least one of a head of the patient and a neck of the patient, the first image data including attenuations from a Compton process . . . receive second image data regarding a second scan at a second energy spectrum, the second scan being a scan of the at least one of the head and the neck, the second image data including attenuations from a photoelectric process . . . represent a material within the received data using at least one of a density of a first reference material and a density of a second reference material . . . and generate a location of a tagging ligand based upon the represented material."

Neither Willson nor Townsend, considered alone or in combination, describes or suggests a Multi-Energy Computed Tomography (MECT) System as recited in Claim 27. More specifically, neither Willson nor Townsend, considered alone or in combination, describes or suggests a MECT that includes a computer configured to receive first image data regarding a first scan at a first energy spectrum, wherein the first image data includes attenuations from a Compton process, and to receive second image data regarding a second scan at a second energy spectrum, wherein the second image data includes attenuations from a photoelectric process. Furthermore, neither Willson nor Townsend, considered alone or in combination, describes or suggests a MECT that includes a computer configured to represent a material within received data using at least one of a density of a first reference material and a density of a second reference material. Moreover, neither Willson nor Townsend, considered alone or in combination, describes or suggests a MECT that includes a computer configured to generate a location of a tagging ligand based upon a represented material. Rather, in contrast to the present invention, Willson describes determining attenuation factors associated with each energy band of a plurality of X-ray fan beams to identify an object according to the determined attenuation factors and reference attenuation factors, and Townsend describes a hybrid scaling method that is based on Compton scattering because Compton scattering is the most important physical process for the interaction of photons with matter.

Accordingly, and for at least the reasons set forth above, Claim 27 is submitted to be patentable over Willson in view of Townsend.

Claim 28 recites a Multi-Energy Computed Tomography (MECT) System configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect, the MECT comprising "a radiation source rotatable about a patient . . . a radiation detector . . . and a computer coupled to said radiation source and said radiation detector, said computer configured to . . . receive first image data regarding a first scan at a first energy spectrum, the scan being a scan of at least one of a head of the patient and a neck of the patient, the first image data including attenuations from a Compton process . . . receive second image data regarding a second scan at a second energy spectrum, the second scan being a scan of the at least one of the head and the neck, wherein the first energy spectrum and the second energy spectrum are within an energy region associated with medical computed tomography (CT), the second image data including attenuations from a photoelectric process . . . represent a material within the received data using at least one of a density of a first reference material and a density of a second reference material . . . and detect a labeled drug based upon the represented material."

As acknowledged on page 4 of the Office Action, Willson does not describe the detection of a labeled drug, as is recited in Claim 28. For this reason alone, Applicants respectfully request that the rejection of Claim 28 be withdrawn.

Moreover, neither Willson nor Townsend, considered alone or in combination, describes or suggests a Multi-Energy Computed Tomography (MECT) System as recited in Claim 28. More specifically, neither Willson nor Townsend, considered alone or in combination, describes or suggests a MECT that includes a computer configured to receive first image data regarding a first scan at a first energy spectrum, wherein the first image data includes attenuations from a Compton process, and to receive second image data regarding a second scan at a second energy spectrum, wherein the second image data includes attenuations from a photoelectric process. Furthermore, neither Willson nor Townsend, considered alone or in combination, describes or suggests a MECT that includes a computer configured to represent a material within received data using at least one of a density of a first reference material and a density of a second reference material. Moreover, neither Willson nor Townsend, considered alone or in combination, describes or suggests a MECT that includes a computer configured to detect a labeled drug based upon a represented material.

Rather, in contrast to the present invention, Willson describes determining attenuation factors associated with each energy band of a plurality of X-ray fan beams to identify an object according to the determined attenuation factors and reference attenuation factors, and Townsend describes a hybrid scaling method that is based on Compton scattering because Compton scattering is the most important physical process for the interaction of photons with matter.

Accordingly, and for at least the reasons set forth above, Claim 28 is submitted to be patentable over Willson in view of Townsend.

Claim 31 recites a Multi-Energy Computed Tomography (MECT) System configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect, the MECT comprising "a radiation source rotatable about a patient . . . a radiation detector . . . and a computer coupled to said radiation source and said radiation detector, said computer configured to . . . receive first image data regarding a first scan at a first energy spectrum, the scan being a scan of a head of the patient, the first image data including attenuations from a Compton process . . . receive second image data regarding a second scan at a second energy spectrum, the second scan being a scan of the head, wherein the first energy spectrum and the second energy spectrum are within an energy region associated with medical computed tomography (CT), the second image data including attenuations from a photoelectric process . . . represent a material within the received data using at least one of a density of a first reference material and a density of a second reference material . . . and classify tissue as cancerous and non-cancerous based upon the represented material."

Neither Willson nor Townsend, considered alone or in combination, describes or suggests a Multi-Energy Computed Tomography (MECT) System as recited in Claim 31. More specifically, neither Willson nor Townsend, considered alone or in combination, describes or suggests a MECT that includes a computer configured to receive first image data regarding a first scan at a first energy spectrum, wherein the first image data includes attenuations from a Compton process, and to receive second image data regarding a second scan at a second energy spectrum, wherein the second image data includes attenuations from a photoelectric process. Furthermore, neither Willson nor Townsend, considered alone or in combination, describes or suggests a MECT that includes a computer configured to represent a material within received data using at least one of a density of a first reference material and a density of a second reference material. Moreover, neither Willson nor Townsend,

considered alone or in combination, describes or suggests a MECT that includes a computer configured to classify tissue as cancerous and non-cancerous based upon a represented material. Rather, in contrast to the present invention, Willson describes determining attenuation factors associated with each energy band of a plurality of X-ray fan beams to identify an object according to the determined attenuation factors and reference attenuation factors, and Townsend describes a hybrid scaling method that is based on Compton scattering because Compton scattering is the most important physical process for the interaction of photons with matter.

Accordingly, and for at least the reasons set forth above, Claim 31 is submitted to be patentable over Willson in view of Townsend.

Applicants respectfully traverse the assertion on page 3 of the Office Action that "Townsend et al. disclose a system and method for scanning various regions of a patient including the head and neck with a CT system acquiring data including attenuations from Compton and photoelectric processes with the multi-energy CT system configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect." Applicants respectfully submit that Townsend describes scanning the thorax and the abdomen with the disclosed PET/CT system to overcome problems associated with organ movement, and that organ movement is not a problem with respect to imaging the skull and brain. Further, Applicants respectfully submit that Townsend does not describe or suggest a multi-energy CT system, but rather Townsend describes a PET/CT system. Moreover, Applicants respectfully submit that Townsend describes using only Compton scatter for hybrid scaling of CT images because the contribution from the photoelectric effect is essentially negligible. Such a description in Townsend teaches away from a Multi-Energy Computed Tomography (MECT) System configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect.

If art "teaches away" from a claimed invention, such a teaching supports the nonobviousness of the invention. U.S. v. Adams, 148 USPQ 479 (1966); Gillette Co. v. S.C. Johnson & Son, Inc., 16 USPQ2d 1923, 1927 (Fed. Cir. 1990). In light of this standard, it is respectfully submitted that the cited art, as a whole, is not suggestive of the presently claimed invention. More specifically, Townsend is directed to a PET/CT system to image the structure and function of organs. Townsend describes that "formation and detection of two CT spectra is technically challenging, requiring either the mechanical switching of foil filters,

or the switching of the X-ray tube accelerating voltage, which is limited by the possibility of overheating. It also generally requires a complex calibration procedure." Col. 6, lines 26-31. As such, one of ordinary skill in the art would not look to Townsend, which describes that formation and detection of multiple CT spectra is challenging and complex, to arrive at the presently pending claims, which are directed to a Multi-Energy CT system.

Furthermore, Applicants respectfully traverse the assertion on page 3 of the Office Action that Willson and Townsend are within the same field of endeavor. In contrast to such an assertion, Applicants respectfully submit that Willson is directed to a plurality of X-ray fan beams each having photons of a known energy distribution of varying energy levels within a fixed energy band, and Townsend is directed to a system that combines PET with CT for imaging structures and functions within a patient and using CT image data to correct PET image data. A combined PET/CT system is not in the same field of endeavor as a detection system that uses X-ray beams each within a different energy band. In fact, combining the recognition system of Willson with the PET/CT system of Townsend would render the recognition system of Willson unsatisfactory for its intended purpose.

If the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. In re Gordon, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984). MPEP § 2143. In the Office Action, the Examiner alleges that it would be obvious to combine Townsend with Willson to produce the presently claimed invention. However, Willson describes that by using X-ray beams within different energy bands, attenuation coefficients for each beam may be used to identify the material of an object being scanned. Without a plurality of X-ray beams within different energy bands, the system of Willson could not detect material of the object as intended. Townsend teaches that a combined PET and CT system may be used to image both the structure and function of an organ. Townsend describes only a single X-ray CT beam at a predetermined energy. As such, it would not have been obvious to one skilled in the art to combine the PET/CT system, as described in Townsend, with the multi-energy band X-ray beams of Willson. Accordingly, for this reason alone, Applicants respectfully request that the Section 103 rejection of Claims 1-6, 8, 14, 18-28, and 31 be withdrawn.

Additionally, in contrast to the assertions in the Office Action, Applicants respectfully submit that it would not have been obvious to one skilled in the art to combine the teachings

of Townsend with the teachings of Willson to arrive at the present invention because Willson also teaches away from the present invention. If art "teaches away" from a claimed invention, such a teaching supports the nonobviousness of the invention. U.S. v. Adams, 148 USPQ 479 (1966); Gillette Co. v. S.C. Johnson & Son, Inc., 16 USPQ2d 1923, 1927 (Fed. Cir. 1990). In light of this standard, it is respectfully submitted that the cited art, as a whole, is not suggestive of the presently claimed invention. More specifically, Townsend teaches away from the present invention for the reasons set forth above, and Willson describes that "[t]he scaling of the attenuation coefficients removes the effect of material density, which is not energy dependent, from the coefficients. The relationship between the scaled coefficients for one material are characteristic of the energy dependence of that material's x-ray attenuation. Hence, we have separated the energy dependence from the density dependence." Col. 7, lines 56-62. As such, one of ordinary skill in the art would not look to Willson, which describes removing the effect of material density, to arrive at the presently pending independent claims, which each include a recitation directed to representing a material within data using at least one of a density of a first reference material and a density of a second reference material. Accordingly, Applicants respectfully request that the Section 103 rejections over Willson in view of Townsend be withdrawn.

For at least the reasons set forth above, Applicants respectfully request that the Section 103 rejection of Claims 1-6, 8, 14, 18-28, and 31 be withdrawn.

The rejection of Claims 15-17 and 29 under 35 U.S.C. § 103(a) as being unpatentable over Willson in view of Townsend, and further in view of U.S. Pat. No. 6,687,333 to Carroll et al. (hereinafter referred to as "Carroll") is respectfully traversed.

Willson and Townsend are described above. Carroll describes a pulsed monochromatic X-ray system (10) that is an integrated unit including a conventional tabletop terawatt laser (1) delivering 10 joules (J) of energy in 1-10 picoseconds (ps) at a wavelength of 1.1 microns. The output infrared (IR) light beam (4) from the laser (1) is counter-propagated against an electron beam produced by a linear accelerator (LINAC) with a photocathode injector (2) and small radiofrequency (RF) accelerator (3) and gun. A beam (9) of X-ray photons is generated by inverse Compton scattering that occurs as a consequence of the collision between the electron beam and IR photons generated by the laser (1). "The term inverse Compton scattering refers to photon scattering by an electron moving at relativistic speeds. Compton scattering is conventionally known as the process in which a photon

scatters off an electron at rest, in which case the photon loses energy to the electron and its wavelength is lengthened. . . . The inverse Compton scattering of a beam of low energy photons backwards by an anti-parallel beam of electrons can produce a narrow beam of high energy photons. In the case of scattering of the photon through 180°, its energy is increased by several orders of magnitude." Col. 4, line 53 – col. 5, line 5. Notably, Carroll does not describe or suggest acquiring, from scanning at two X-ray tube potentials, first image data including attenuations from a Compton process and second image data including attenuations from a photoelectric process.

Furthermore, Carroll describes that "[b]ecause the system is tunable, an X-ray wavelength can be selected that is most suited to a specific imaging task. For example, the optimal wavelength for imaging a breast is quite different from the optimal wavelengths for imaging the chest or brain. In addition, the X-rays generated by this system are inherently of narrow bandwidth as opposed to the relatively continuous broad spectrum X-rays produced by conventional X-ray tubes. The narrow bandwidth and tunability improve tissue discrimination and allow for improvements in contrast resolution, spatial resolution, and temporal resolution for all procedures." Col. 3, lines 36-46. Accordingly, Applicants respectfully submit that Carroll teaches away from a multi-energy CT system, as recited in the presently pending claims.

If art "teaches away" from a claimed invention, such a teaching supports the nonobviousness of the invention. U.S. v. Adams, 148 USPQ 479 (1966); Gillette Co. v. S.C. Johnson & Son, Inc., 16 USPQ2d 1923, 1927 (Fed. Cir. 1990). In light of this standard, it is respectfully submitted that the cited art, as a whole, is not suggestive of the presently claimed invention. More specifically, Carroll is directed to a pulsed monochromatic X-ray system that generates an X-ray beam with a narrow bandwidth and short duration. Carroll describes that the narrow bandwidth and tunability of the single X-ray beam improve tissue discrimination and allow for improvements in contrast resolution, spatial resolution, and temporal resolution for all procedures. As such, one of ordinary skill in the art would not look to Carroll, which describes generating an X-ray beam with a tunable, narrow bandwidth, to arrive at the presently pending independent claims, which each recite a Multi-Energy CT system.

Moreover, Carroll is directed to using inverse Compton scattering to generate an X-ray beam from a laser and an electron beam. Carroll describes that by using inverse Compton

scattering, electrons can produce a narrow X-ray beam of high energy photons, wherein the energy is increased by several orders of magnitude. As such, one of ordinary skill in the art would not look to Carroll, which describes generating an X-ray beam using inverse Compton scattering, to arrive at the presently pending independent claims, which each include a recitation directed to a Multi-Energy Computed Tomography System configured to be *responsive to* different *x-ray spectra associated with Compton scatter* and photoelectric effect. (Emphasis added.) Accordingly, Applicants respectfully request that the Section 103 rejection of Claims 15-17 and 29 be withdrawn.

Furthermore, none of Willson, Townsend, and Carroll, considered alone or in combination, describes or suggests the recitations of the presently pending claims. More specifically, Claim 1 recites a method for obtaining data, said method comprising "scanning at least one of a head of a patient and a neck of the patient with a Multi-Energy Computed Tomography (MECT) system, the MECT including an x-ray source rotatable about the patient, the MECT configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect and within an energy region associated with medical computed tomography (CT) . . . acquiring, from said scanning, first image data including attenuations from a Compton process and second image data including attenuations from a photoelectric process . . . and representing a material within the acquired image data using at least one of a density of a first reference material and a density of a second reference material."

None of Willson, Townsend, and Carroll, considered alone or in combination, describes or suggests a method for obtaining data as recited in Claim 1. More specifically, none of Willson, Townsend, and Carroll, considered alone or in combination, describes or suggests a method that includes acquiring, from scanning at two X-ray tube potentials, first image data including attenuations from a Compton process and second image data including attenuations from a photoelectric process. Furthermore, none of Willson, Townsend, and Carroll, considered alone or in combination, describes or suggests a method that includes representing a material within acquired image data using at least one of a density of a first reference material and a density of a second reference material. Rather, in contrast to the present invention, Willson describes determining attenuation factors associated with each energy band of a plurality of X-ray fan beams to identify an object according to the determined attenuation factors and reference attenuation factors, Townsend describes a

hybrid scaling method that is based on Compton scattering because Compton scattering is the most important physical process for the interaction of photons with matter, and Carroll describes a pulsed monochromatic X-ray system for generating an X-ray beam with a narrow bandwidth and short duration.

Accordingly, and for at least the reasons set forth above, Claim 1 is submitted to be patentable over Willson in view of Townsend, and further in view of Carroll.

Claims 15-17 depend from independent Claim 1. When the recitations of Claims 15-17 are considered in combination with the recitations of Claim 1, Applicants submit that dependent Claims 15-17 likewise are patentable over Willson in view of Townsend, and further in view of Carroll.

Claim 29 recites a Multi-Energy Computed Tomography (MECT) System configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect, the MECT comprising "a radiation source rotatable about a patient . . . a radiation detector . . . and a computer coupled to said radiation source and said radiation detector, said computer configured to . . . receive first image data regarding a first scan at a first energy spectrum, the scan being a scan of a head of the patient, the first image data including attenuations from a Compton process . . . receive second image data regarding a second scan at a second energy spectrum, the second scan being a scan of the head, wherein the first energy spectrum and the second energy spectrum are within an energy region associated with medical computed tomography (CT), the second image data including attenuations from a photoelectric process . . . represent a material within the received data using at least one of a density of a first reference material and a density of a second reference material . . . generate a location of a tagged ligand with an affinity to a neurotransmitter released by a specific labeled drug's receptors based upon the represented material . . . and detect a labeled drug based upon the received data to simultaneously monitor the labeled drug's distribution and a concentration of the neurotransmitter."

None of Willson, Townsend, and Carroll, considered alone or in combination, describes or suggests a Multi-Energy Computed Tomography (MECT) System as recited in Claim 29. More specifically, none of Willson, Townsend, and Carroll, considered alone or in combination, describes or suggests a MECT that includes a computer configured to receive first image data regarding a first scan at a first energy spectrum, wherein the first image data

includes attenuations from a Compton process, and to receive second image data regarding a second scan at a second energy spectrum, wherein the second image data includes attenuations from a photoelectric process. Furthermore, none of Willson, Townsend, and Carroll, considered alone or in combination, describes or suggests a MECT that includes a computer configured to represent a material within received data using at least one of a density of a first reference material and a density of a second reference material. Moreover, none of Willson, Townsend, and Carroll, considered alone or in combination, describes or suggests a MECT that includes a computer configured to generate a location of a tagged ligand with an affinity to a neurotransmitter released by a specific labeled drug's receptors based upon a represented material. Rather, in contrast to the present invention, Willson describes determining attenuation factors associated with each energy band of a plurality of X-ray fan beams to identify an object according to the determined attenuation factors and reference attenuation factors, Townsend describes a hybrid scaling method that is based on Compton scattering because Compton scattering is the most important physical process for the interaction of photons with matter, and Carroll describes a pulsed monochromatic X-ray system for generating an X-ray beam with a narrow bandwidth and short duration.

Accordingly, and for at least the reasons set forth above, Claim 29 is submitted to be patentable over Willson in view of Townsend, and further in view of Carroll.

For at least the reasons set forth above, Applicants request that the Section 103 rejection of Claims 15-17 and 29 be withdrawn.

The rejection of Claims 7, 9-12, 25, 26, and 30 under 35 U.S.C. § 103(a) as being unpatentable over Willson in view of Townsend, and further in view of U.S. Pat. No. 6,754,298 to Fessler (hereinafter referred to as "Fessler") is respectfully traversed.

Willson and Townsend are described above. Fessler describes a method for statistically reconstructing images from a plurality of transmission measurements having energy diversity. One "conventional" simplification of a general physical model is a Basis Material Decomposition (BMD) that models an object's linear attenuation coefficient ($\mu(\vec{x}, \varepsilon)$) as a function of either an energy variable ($f_1(\varepsilon)$) and a spatial variable ($\alpha_1(\vec{x})$) or an energy-dependent mass-attenuation coefficient ($\beta_1(\varepsilon)$) and a density of a material ($\rho_1(\vec{x})$) at a spatial location ($\vec{x}$). However, Fessler describes that such a simplification is not general enough, and, instead that the method for statistically reconstructing images is more general

and does not require separability. Accordingly, Fessler is directed to a method for statistically reconstructing images from a plurality of transmission measurements having energy diversity, wherein the method does not use a BMD. Further, Fessler does not describe or suggest acquiring, from scanning at two X-ray tube potentials, first image data including attenuations from a Compton process and second image data including attenuations from a photoelectric process.

Claim 1 recites a method for obtaining data, said method comprising "scanning at least one of a head of a patient and a neck of the patient with a Multi-Energy Computed Tomography (MECT) system, the MECT including an x-ray source rotatable about the patient, the MECT configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect and within an energy region associated with medical computed tomography (CT) . . . acquiring, from said scanning, first image data including attenuations from a Compton process and second image data including attenuations from a photoelectric process . . . and representing a material within the acquired image data using at least one of a density of a first reference material and a density of a second reference material."

None of Willson, Townsend, and Fessler, considered alone or in combination, describes or suggests a method for obtaining data as recited in Claim 1. More specifically, none of Willson, Townsend, and Fessler, considered alone or in combination, describes or suggests a method that includes acquiring, from scanning at two X-ray tube potentials, first image data including attenuations from a Compton process and second image data including attenuations from a photoelectric process. Furthermore, none of Willson, Townsend, and Fessler, considered alone or in combination, describes or suggests a method that includes representing a material within acquired image data using at least one of a density of a first reference material and a density of a second reference material. Rather, in contrast to the present invention, Willson describes determining attenuation factors associated with each energy band of a plurality of X-ray fan beams to identify an object according to the determined attenuation factors and reference attenuation factors, Townsend describes a hybrid scaling method that is based on Compton scattering because Compton scattering is the most important physical process for the interaction of photons with matter, and Fessler describes a method for statistically reconstructing images from transmission measurements having energy diversity.

Accordingly, and for at least the reasons set forth above, Claim 1 is submitted to be patentable over Willson in view of Townsend, and further in view of Fessler.

Claims 7 and 9-12 depend from independent Claim 1. When the recitations of Claims 7 and 9-12 are considered in combination with the recitations of Claim 1, Applicants submit that dependent Claims 7 and 9-12 likewise are patentable over Willson in view of Townsend, and further in view of Fessler.

Claim 23 recites a Multi-Energy Computed Tomography (MECT) System configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect, the MECT comprising "a radiation source rotatable about a patient . . . a radiation detector . . . and a computer coupled to said radiation source and said radiation detector, said computer configured to . . . receive first image data regarding a first scan at a first energy spectrum, the scan being a scan of a head of the patient, the first image data including attenuations from a Compton process . . . receive second image data regarding a second scan at a second energy spectrum, the second scan being a scan of the head, wherein the first energy spectrum and the second energy spectrum are within an energy region associated with medical computed tomography (CT), the second image data including attenuations from a photoelectric process . . . generate an image of at least one of a cerebral blood volume of the patient and a cerebral blood flow of the patient using the first and second image data, wherein a material within at least one of the cerebral blood volume and the cerebral blood flow is represented using at least one of a density of a first reference material and a density of a second reference material . . . and calculate a mean transit time of the cerebral blood flow based on the received data."

None of Willson, Townsend, and Fessler, considered alone or in combination, describes or suggests a Multi-Energy Computed Tomography (MECT) System as recited in Claim 23. More specifically, none of Willson, Townsend, and Fessler, considered alone or in combination, describes or suggests a MECT that includes a computer configured to receive first image data regarding a first scan at a first energy spectrum, wherein the first image data includes attenuations from a Compton process, and to receive second image data regarding a second scan at a second energy spectrum, wherein the second image data includes attenuations from a photoelectric process. Furthermore, none of Willson, Townsend, and Fessler, considered alone or in combination, describes or suggests a MECT that includes a computer configured to generate an image of at least one of a cerebral blood volume of a

patient and a cerebral blood flow of the patient, wherein a material within at least one of the cerebral blood volume and the cerebral blood flow is represented using at least one of a density of a first reference material and a density of a second reference material. Moreover, none of Willson, Townsend, and Fessler, considered alone or in combination, describes or suggests a MECT that includes a computer configured to calculate a mean transit time of a cerebral blood flow based on received data.

Rather, in contrast to the present invention, Willson describes determining attenuation factors associated with each energy band of a plurality of X-ray fan beams to identify an object according to the determined attenuation factors and reference attenuation factors, Townsend describes a hybrid scaling method that is based on Compton scattering because Compton scattering is the most important physical process for the interaction of photons with matter, and Fessler describes a method for statistically reconstructing images from transmission measurements having energy diversity.

Accordingly, and for at least the reasons set forth above, Claim 23 is submitted to be patentable over Willson in view of Townsend, and further in view of Fessler.

Claims 25 and 26 depend from independent Claim 23. When the recitations of Claims 25 and 26 are considered in combination with the recitations of Claim 23, Applicants submit that dependent Claims 25 and 26 likewise are patentable over Willson in view of Townsend, and further in view of Fessler.

Claim 30 recites a Multi-Energy Computed Tomography (MECT) System configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect, the MECT comprising "a radiation source rotatable about a patient . . . a radiation detector . . . and a computer coupled to said radiation source and said radiation detector, said computer configured to . . . receive first image data regarding a first scan at a first energy spectrum, the scan being a scan of a head of the patient, the first image data including attenuations from a Compton process . . . receive second image data regarding a second scan at a second energy spectrum, the second scan being a scan of the head, wherein the first energy spectrum and the second energy spectrum are within an energy region associated with medical computed tomography (CT), the second image data including attenuations from a photoelectric process . . . and perform a Basis Material Decomposition (BMD) of the received data to characterize a plaque in a carotid artery, wherein performing a BMD

comprises representing a material within the received data using at least one of a density of a first reference material and a density of a second reference material."

None of Willson, Townsend, and Fessler, considered alone or in combination, describes or suggests a Multi-Energy Computed Tomography (MECT) System as recited in Claim 30. More specifically, none of Willson, Townsend, and Fessler, considered alone or in combination, describes or suggests a MECT that includes a computer configured to receive first image data regarding a first scan at a first energy spectrum, wherein the first image data includes attenuations from a Compton process, and to receive second image data regarding a second scan at a second energy spectrum, wherein the second image data includes attenuations from a photoelectric process. Furthermore, none of Willson, Townsend, and Fessler, considered alone or in combination, describes or suggests a MECT that includes a computer configured to perform a Basis Material Decomposition (BMD) of received data to characterize a plaque in a carotid artery, wherein performing a BMD includes representing a material within the received data using at least one of a density of a first reference material and a density of a second reference material. Rather, in contrast to the present invention, Willson describes determining attenuation factors associated with each energy band of a plurality of X-ray fan beams to identify an object according to the determined attenuation factors and reference attenuation factorst, Townsend describes a hybrid scaling method that is based on Compton scattering because Compton scattering is the most important physical process for the interaction of photons with matter, and Fessler describes a method for statistically reconstructing images from transmission measurements having energy diversity.

Accordingly, and for at least the reasons set forth above, Claim 30 is submitted as patentable over Willson in view of Townsend, and further in view of Fessler.

Additionally, in contrast to the assertions in the Office Action, Applicants respectfully submit that it would not have been obvious to one skilled in the art to combine the teachings of Fessler with the teachings of Willson and Townsend to arrive at the present invention. More specifically, Applicants submit that Fessler teaches away from the present invention. If art "teaches away" from a claimed invention, such a teaching supports the nonobviousness of the invention. U.S. v. Adams, 148 USPQ 479 (1966); Gillette Co. v. S.C. Johnson & Son, Inc., 16 USPQ2d 1923, 1927 (Fed. Cir. 1990). In light of this standard, it is respectfully submitted that the cited art, as a whole, is not suggestive of the presently claimed invention. More specifically, Fessler describes that Basis Material Decomposition (BMD) is not a

general enough algorithm, and, that instead of using the BMD, a more general algorithm that does not require separability should be used for reconstructing images from tomographic measurements with energy diversity. As such, one of ordinary skill in the art would not look to Fessler, which describes an algorithm to use instead of using BMD algorithms, to arrive at the presently pending claims, which recite performing a Basis Material Decomposition. Accordingly, Applicants respectfully request that the Section 103 rejection of Claims 7, 9-12, 25, 26, and 30 be withdrawn.

Further, Applicants respectfully submit that the Section 103 rejection of Claims 7, 9-12, 25, 26, and 30 is not a proper rejection. As is well established, the mere fact that the prior art structure could be modified does not make such a modification obvious unless the prior art suggests the desirability of doing so. *See* In re Gordon, 221 USPQ2d 1125 (Fed. Cir. 1984). The Federal Circuit has determined that:

> [i]t is impermissible to use the claimed invention as an instruction manual or "template" to piece together the teachings of the prior art so that the claimed invention is rendered obvious. This court has previously stated that "[o]ne cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention.

In re Fritch, 23 USPQ2d 1780, 1784 (Fed. Cir. 1992). Under Section 103, "it is impermissible . . . to pick and choose from any one reference only so much of it as will support a given position, to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one of ordinary skill in the art." In re Wesslau, 147 USPQ 391, 393 (CCPA 1965).

As such, it is improper to look only to Fessler for teaching the use of Basis Material Decomposition without fully appreciating what Fessler fairly suggests. Applicants respectfully submit that Fessler fairly suggests to one skilled in the art that Basis Material Decomposition algorithms are not general enough for reconstructing images from tomographic measurements with energy diversity. More specifically, Fessler describes that "[the BMD] parameterization facilitates enforcing physical constraints such as non-negativity. Both of the [BMD] parameterizations use bases that are separable in space/energy. This separability property is needed for the type of algorithm derived in previous work. The more general algorithm derived in this paper does not require separability. A more general parameterization is described in (23) below after reviewing

conventional approaches." Col. 8, lines 27-36. Accordingly, the assertion on page 5 of the Office Action that "[i]t would have therefore been obvious to one of ordinary skill in the art to use the teaching by Fessler to modify the teaching by Townsend et al. for the purpose of reducing image artifacts and improving image contrast," is impermissible under Section 103 as "picking and choosing" to support a position without looking to other necessary parts of Fessler to fully appreciate what Fessler suggests to one skilled in the art.

Rather, Applicants respectfully submit that Fessler supports, taken as a whole, the position that algorithms other than Basis Material Decomposition should be used when reconstructing images from tomographic measurements with energy diversity, and, as such, it is not obvious to combine the algorithm of Fessler with systems of Willson and Townsend to arrive at the present invention. Accordingly, the Section 103 rejection appears to be based on a hindsight reconstruction in which isolated disclosures have been picked and chosen in an attempt to deprecate the present invention. Of course, such a combination is impermissible, and for this reason alone, Applicants respectfully request that the Section 103 rejection of Claims 7, 9-12, 25, 26, and 30 be withdrawn.

For at least the reasons set forth above, Applicants request that the Section 103 rejection of Claims 7, 9-12, 25, 26, and 30 be withdrawn.

The rejection of Claim 13 under 35 U.S.C. § 103(a) as being unpatentable over Willson in view of Townsend, and further in view of U.S. Pat. No. 5,269,315 to Leuchter et al. (hereinafter referred to as "Leuchter") is respectfully traversed.

Willson and Townsend are described above. Leuchter describes a method for determining electrical output of a brain region using electroencephalography (EEG). The method includes obtaining first data representative of energy in the brain region in a primary frequency domain, and simultaneously obtaining second data representative of energy in the primary frequency domain relative to the energy in a secondary frequency domain. The first and second data are then related to obtain a representative value of the electrical output in the brain region. The representative values are quantified relative to the departure of the first data and second data from a simultaneously obtained selected base value to determine if the values are concordance or discordance values. A concordance value and a discordance value are quantified and mapped topographically relative to the brain region to assess and assist diagnosing disorders and afflictions characterized by lesions in the brain. Leuchter uses EEG

because "PET and SPECT scanning are expensive, requiring investments of millions of dollars initially. Also required are many hours of technician time per test and the production and injection of radionuclides into a patient." Col. 1, lines 51-54. Notably, Leuchter does not describe or suggest a Multi-Energy CT system. Further, Leuchter does not describe or suggest acquiring, from scanning at two X-ray tube potentials, first image data including attenuations from a Compton process and second image data including attenuations from a photoelectric process.

Claim 1 recites a method for obtaining data, said method comprising "scanning at least one of a head of a patient and a neck of the patient with a Multi-Energy Computed Tomography (MECT) system, the MECT including an x-ray source rotatable about the patient, the MECT configured to be responsive to different x-ray spectra associated with Compton scatter and photoelectric effect and within an energy region associated with medical computed tomography (CT) . . . acquiring, from said scanning, first image data including attenuations from a Compton process and second image data including attenuations from a photoelectric process . . . and representing a material within the acquired image data using at least one of a density of a first reference material and a density of a second reference material."

None of Willson, Townsend, and Leuchter, considered alone or in combination, describes or suggests a method for obtaining as recited in Claim 1. More specifically, none of Willson, Townsend, and Leuchter, considered alone or in combination, describes or suggests a method that includes acquiring, from scanning at two X-ray tube potentials, first image data including attenuations from a Compton process and second image data including attenuations from a photoelectric process. Furthermore, none of Willson, Townsend, and Leuchter, considered alone or in combination, describes or suggests a method that includes representing a material within acquired image data using at least one of a density of a first reference material and a density of a second reference material. Rather, in contrast to the present invention, Willson describes determining attenuation factors associated with each energy band of a plurality of X-ray fan beams to identify an object according to the determined attenuation factors and reference attenuation factors, Townsend describes a hybrid scaling method that is based on Compton scattering because Compton scattering is the most important physical process for the interaction of photons with matter, and Leuchter describes determining brain lesions by quantified electroencephalography.

Accordingly, and for at least the reasons set forth above, Claim 1 is submitted to be patentable over Willson in view of Townsend, and further in view of Leuchter.

Claim 13 depends from independent Claim 1. When the recitations of Claim 13 are considered in combination with the recitations of Claim 1, Applicants submit that dependent Claim 13 likewise is patentable over Willson in view of Townsend, and further in view of Leuchter.

Further, Applicants respectfully submit that the Section 103 rejection of Claim 13 is not a proper rejection. As is well established, and discussed above, the mere fact that the prior art structure could be modified does not make such a modification obvious unless the prior art suggests the desirability of doing so. *See* In re Gordon, 221 USPQ2d 1125 (Fed. Cir. 1984). As such, it is improper to look only to Leuchter for teaching "a method and apparatus of obtaining information pertaining to brain lesions and diseases such as mild dimension and Alzheimer's Disease" without fully appreciating what Leuchter fairly suggests. See Office Action at page 5. Applicants respectfully submit that Leuchter fairly suggests to one skilled in the art that PET and/or SPECT scanning are expensive and time consuming while cordance brain mapping from EEG scanning is comparable in quality, but less expensive and faster than PET and/or SPECT.

More specifically, Leuchter describes that "PET and SPECT scanning are expensive, requiring investments of millions of dollars initially. Also required are many hours of technician time per test and the production and injection of radionuclides into a patient." Col. 1, lines 51-54. Leuchter further describes that "[i]t may be unnecessary to resort to the relatively expensive SPECT and PET techniques. The diseases represented by the information obtained by cordance brain mapping are the result of deep lesions in the brain that produce excessive delta and theta slow wave activity in an EEG." Col. 14, lines 30-35. Townsend is directed to a combined PET and CT system. Accordingly, the assertion at page 5 of the Office Action that "[i]t would have therefore been obvious to one of ordinary skill in the art to use the teaching by Leuchter to modify the teaching by Townsend et al. for the purpose of detecting and analyzing specific neurological disorders such as Alzheimer's Disease," is impermissible under Section 103 as "picking and choosing" to support a position without looking to other necessary parts of Leuchter to fully appreciate what Leuchter suggests to one skilled in the art.

Moreover, Applicants respectfully submit that Leuchter, taken as a whole, supports the position that using EEG scan data has advantages over using PET and SPECT scan data, and, as such, it is not obvious to combine the X-ray system of Willson and the PET/CT system of Townsend with the EEG scan method of Leuchter. Accordingly, the Section 103 rejection appears to be based on a hindsight reconstruction in which isolated disclosures have been picked and chosen in an attempt to deprecate the present invention. Of course, such a combination is impermissible, and for this reason alone, Applicants respectfully request that the Section 103 rejection of Claim 13 be withdrawn.

For at least the reasons set forth above, Applicants request that the Section 103 rejection of Claim 13 be withdrawn.

In view of the foregoing amendment and remarks, all the claims now active in this application are believed to be in condition for allowance. Reconsideration and favorable action is respectfully requested.

Respectfully Submitted,

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